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DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN OR RELATING TO PNEUMATIC SPRING SUSPENSION SYSTEMS FOR VEHICLES

(71) We, MASCHINENFABRIK AUGSBURG-NURNBERG AKTIENGESELLSCHAFT, a German Body Corporate, of Nürnberg, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a vehicle suspension system for vehicles, particularly, but not exclusively for rail vehicles, having an air spring in the form of an open annulus having two peripheral edges of different diameter and arranged between an unsprung part and a sprung part of the vehicle.

It is generally known in vehicle engineering, and especially in rail vehicles, to mount the vehicle body on bogies (or trucks) by means of air springs and to design these air springs in the form of an open annulus. The peripheral edges of these air springs are designed with different diameters and clamped in clamping rings which also have different diameters. In such a suspension, the clamping rings are firmly connected to the wheel part and body part and, preferably, the larger diameter ring is attached to the body part and the smaller diameter ring is, *via* a cylindrical structure, attached to the bogie frame permitting free spring deflection in the vertical direction. In order to limit the spring deflection of the air spring in the vertical direction and, in the case of air leakage from the air spring to ensure a minimum degree of spring action and, thereby, to reduce the risk of derailment of the rail vehicle, it is known to provide an auxiliary spring inside the cylinder of each air spring mounted on the free end of a strut which is solidly connected to the bogie frame. This auxiliary spring takes the form of a rubber spring and, at one end thereof facing the larger-diameter clamping ring, is provided with a striker plate the diameter of which is substantially smaller than the inside diameter of the smaller-diameter clamping ring. Underneath the auxiliary spring, a secondary air reservoir is provided in the frame of the bogie, opening towards the air spring to increase the effective air volume providing spring action in the air spring system. By clamping the air spring in rings positioned at different levels, the air spring is imparted, in addition to vertical and horizontal resilience, a centering action by which the air spring is returned to its initial position after any lateral deflection.

The invention provides a vehicle suspension system for supporting a sprung part on a unsprung part, the suspension system comprising an air spring in the form of an open annulus having two peripheral edges of different diameter one peripheral edge being fixed to the sprung part or the unsprung part, and the other peripheral edge being fixed to an additional spring arranged in series with the air spring and connected to the unsprung part or the sprung part, respectively, so that both the air spring and the additional spring of the suspension system are resilient not only along the longitudinal axis of the springs, but also at right angles thereto.

By connecting one of the peripheral edges of the air spring to the unsprung part or sprung part and the other peripheral edge to the additional spring, this additional spring shares in both the vertical spring action and the horizontal spring action, e.g. when the vehicle travels along a sharp bend. This makes it possible to attain a much softer spring suspension and, moreover, to meet the requirements in respect of safety against derailment in a more effective and simpler fashion.

A further advantage of this invention is that the additional spring sharing in the vertical load transmission can be preloaded

to suit the payload carried by the vehicle. In addition, spring action in the lateral direction also becomes softer. Consequently, supporting of the whole load of the vehicle body is not, as in existing practice, either by the air spring alone or, on failure of the air spring, by the additional spring alone. Furthermore, the proposed suspension system according to this invention affords improved riding conditions for passenger transport whereby the standard of comfort of e.g. rail travel is substantially enhanced.

The said additional spring may take the form of a conventional coil or rubber spring.

In order to increase the effective volume of the air spring an auxiliary reservoir is connected to the air spring. When the additional spring is in the form of a rubber spring a communicating passage is provided through the additional auxiliary spring to connect the air spring with the reservoir.

In cases where the vehicle design permits the reservoir to be fitted in the vehicle body it is possible to arrange the reservoir adjacent the air spring and to connect the reservoir with the air spring by an aperture.

One or more additional springs are provided between the larger-diameter peripheral edge of the air spring and the sprung part of the vehicle.

The invention will be further described with reference to a few typical embodiments shown schematically in the accompanying drawings, wherein:

Fig. 1 is a suspension system according to the invention having a rubber spring interposed between the smaller-diameter peripheral edge and the unsprung part,

Fig. 2 is a suspension system having a coil spring interposed between the smaller diameter peripheral edge and the unsprung part,

Fig. 3 is a suspension system as in Fig. 1 with a reservoir in the bogie frame communicating with the air spring,

Fig. 4 is a suspension system as in Fig. 2 with a reservoir in the vehicle body communicating with the air spring,

Fig. 5 is a suspension system as in Fig. 1 with a reservoir in the vehicle body communicating with the air spring,

Fig. 6 is a suspension system similar to that in Fig. 3 with several rubber springs or, alternatively, only one rubber spring interposed between the larger diameter peripheral edge and the sprung part,

Fig. 7 is a suspension system as in Fig. 6 with one coil spring or, alternatively, several coil springs interposed between the larger-diameter peripheral edge and the vehicle body,

Fig. 8 is a suspension system corresponding to that in Fig. 3 having a stressed-in-shear rubber spring interposed between the reservoir and the smaller-diameter peripheral edge, and

Fig. 9 is a suspension system as in Fig. 5, but with the air spring inverted.

The suspension system consists essentially of an air spring in the form of an open annulus 1 having two peripheral edges 2, 3 of different diameter. The larger-diameter peripheral edge 2 is clamped by means of a clamping ring 4 to a sprung part 6 of the vehicle body to be supported. The other, smaller diameter peripheral edge 3 is fixedly connected to a supporting element 5 mounted on a supporting disc 8. The supporting disc 8 is connected to an unsprung part 7 of the vehicle, e.g. a bogie of a rail vehicle, *via* an additional spring which may take the form of a tiered rubber spring 9 as shown in Fig. 1, or a progressive action hollow rubber spring not shown, or a coil spring 10 as shown in Fig. 2. The supporting disc 8 is connected rigidly to the rubber spring 9 or coil spring 10 so that the supporting disc 8, and hence the supporting element 5 and the peripheral edge 3 connected thereto, are compelled to move together with the additional spring as the latter is deflected vertically or horizontally. Horizontal deflection of the additional spring takes place, for example, when a rail vehicle travels on a tightly curved track.

Within the perimeter of the clamping ring 4, a striker plate 11 is attached to the ring itself or to the vehicle sprung part 6. The striker plate 11, on full deflection or failure of the air spring 1, will come to rest on the supporting disc 8 and consequently on the additional spring. During normal functioning of the suspension system both springs 1 and 9 or 10, co-operate in providing spring action between the vehicle parts 6 and 7. The air spring 1 and the additional spring 9 are capable of resilient deflection in both the vertical and horizontal directions and, moreover, tend to return the vehicle parts 6 and 7 to their undeflected position relative to each other.

In the embodiment illustrated in Fig. 3, the air spring 1 is connected to a tank 12 to increase the effective air volume providing spring action. The tank 12 is fixed to the unsprung part 7. Where the unsprung part 7 is the bogie of a rail vehicle ((not shown), the tank 12 would be arranged in a recess of the frame and the spring 9′ on the upper deck plate of said frame. So that the extra volume of the tank 12 can be effective for spring action, the space 13 of the tank 12 communicates with the space 14 of the bellows 1 via a passage 15 provided in the spring 9′. The spring 9′ supporting the supporting disc 5 in this example is substantially similar to the rubber spring 9

in Fig. 1. In this example the air spring 1, spring 9′ and extra volume, i.e. space 13, co-operate to provide spring suspension of the sprung part 6 on the unsprung part 7.

The suspension system shown in Fig. 4 functions in the same manner as that shown in Fig. 3 from which it differs in that a coil spring 10 is provided instead of the rubber spring 9′, and also in that the extra volume tank 12, for increasing the effective air spring volume, is fixed to the sprung part 6. An opening 16 is provided in the sprung part 6 through which space 13 of the tank 12 communicates with the space 14 of the air spring 1.

The suspension system illustrated in Fig. 5 is similar to that of Fig. 4 differing only in that a rubber spring 9 is provided instead of the coil spring 10.

The suspension systems shown in Figs. 6 and 7 correspond in their functions to those shown in Figs. 3, 4 and 5, differing from the latter in that the additional rubber springs 9 (Fig. 6) or coil springs 10 (Fig. 7) are now interposed between the clamping ring 4 and the sprung part 6 instead of being allied with the supporting disc 8. One or more springs 9 or 10 may be provided as required between the clamping ring 5 and the sprung part 6, e.g. the body of a rail vehicle (not shown).

Where it is desired to increase the effective volume of the air spring 1 an associated tank 12 is provided which comprises a rigid cylindrical structure 18 supporting the disc 8 and having a space 17 therein, and may also comprise a tank 12 arranged in the frame of the bogie and having a space 13. Communication between the spaces 13, 14 and 17 is effected similarly to the previous examples by suitable openings 16.

The suspension shown in Fig. 8 functions similarly to that shown in Fig. 3 and incorporates a stress-in-shear rubber spring 20 instead of the tiered rubber spring 9′. The stressed-in-shear spring 20 has tilted supporting surfaces 21 and 22 which bear against the disc 8 at one side and against the unsprung part 7, e.g. a bogie, at the other side.

The suspension system illustrated in Fig. 9 functions similarly to those of the above-described suspensions in which the air spring 1 is provided with a tank 13, and differs in that the air spring 1 is inverted.

WHAT WE CLAIM IS:—

1. A vehicle suspension system for supporting a sprung part on an unsprung part, the suspension system comprising an air spring in the form of an open annulus having two peripheral edges of different diameter one peripheral edge being fixed to the sprung part or the unsprung part, and the other peripheral edge being fixed to an additional spring arranged in series with the air spring and connected to the unsprung part or the sprung part, respectively, so that both the air spring and the additional spring of the suspension system are resilient not only along the longitudinal axis of the springs, but also at right angles thereto.

2. A suspension system as claimed in claim 1, wherein the additional spring is a rubber spring.

3. A suspension system as claimed in claim 1, wherein the additional spring is a coil spring.

4. A suspension system as claimed in any of claims 1 to 3, wherein the air spring is connected to an auxiliary air reservoir so as to increase the effective volume of the air spring.

5. A suspension system as claimed in claim 4, wherein the additional spring is a rubber spring, and the air reservoir is situated adjacent the rubber spring and is connected to the air spring by means of a conduit through the rubber spring.

6. A suspension system as claimed in claim 4, wherein the auxiliary air reservoir is situated adjacent the air spring and communicates with the air spring through an aperture.

7. A suspension system as claimed in claim 4, wherein the additional spring, or more than one additional spring, is provided between the larger-diameter peripheral edge of the air spring and the sprung part of the vehicle.

8. A suspension system substantially as herein described with reference to any one of the Figures of the accompanying drawings.

9. A vehicle having a sprung part supported on an unsprung part by means of a suspension system as claimed in any one of the preceding claims.

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3 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

Fig 1

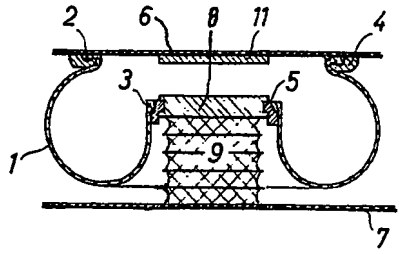


Fig. 2

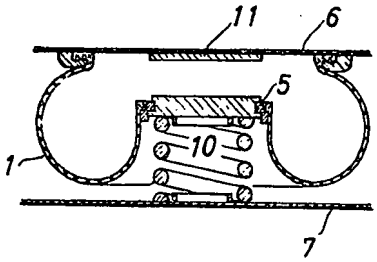


Fig. 3

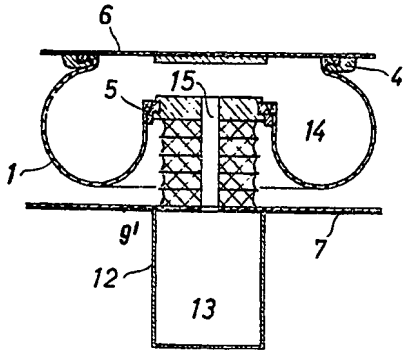


Fig. 4

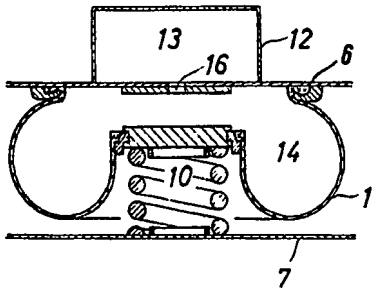


Fig. 5

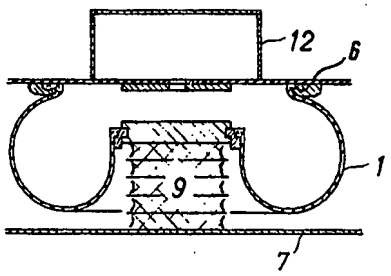


Fig. 6

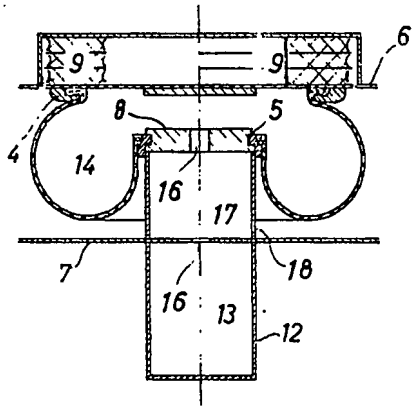


Fig. 7

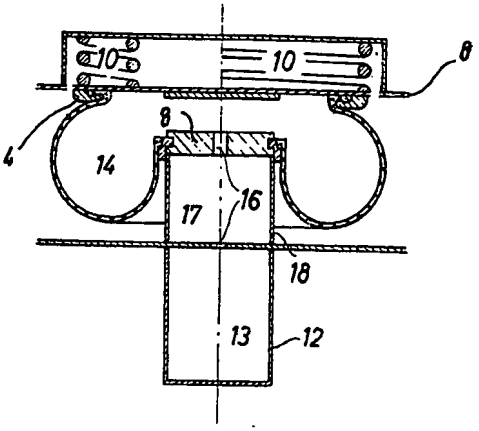


Fig. 8

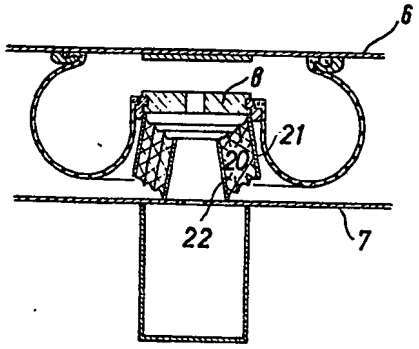
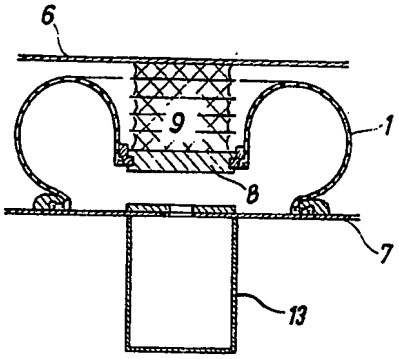


Fig. 9



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more >>

Abstract of **GB1232121**

1,232,121. Rail vehicle suspensions. MASCHINENFABRIK AUGSBURG - NURNBERG A.G. 15 July, 1968 [22 July, 1967], No. 33629/68. Headings B7D and B7L. [Also in Division F2] A (rail) vehicle suspension comprises an air spring 1 in the form of an open annulus having peripheral beaded edges 2, 3 of different diameters and connected in series to a rubber spring 9 or coil spring 10, the arrangement providing flexibility at right angles to the springs' axes. The capacity of the air spring may be augmented by an auxiliary chamber 12, Figs. 3 or 4. The rubber or coil springs may be replaced by a number of rubber or coil springs, respectively, acting in series. As shown in Fig. 7, one or more coil springs are connected to the air spring at its larger diameter edge, the smaller diameter edge being connected to a cylindrical member 18. The rubber spring may act in shear, as shown at 20 in Fig. 8.